Electromagnetic Engineering (EC 21006)
T U T O R I A L - IX

TRANSMISSION LINES -- FREQUENCY DOMAIN ANALYSIS

1. A lossless transmission line with $Z_0 = 60\Omega$ is being operated at 60 MHz. The velocity of the line is $3 \times 10^8 m/s$. If the line is short-circuited at $z = 0$,find Z_{in} at $z =: (a) - 1m;\ (b) - 2m;$ $(c) - 2.5m\ ; (d) - 1.25m.$
2. The characteristic impedance of a certain lossless transmission line is 72Ω.If $L = 0.5\mu H/m$, find: (a) C; (b) v_p; (c) β if $f = 80\ MHz$. (d) The line is terminated with a load of 60Ω. Find Γ and s.
3. A lossless transmission line having $Z_0 = 120\Omega$ is operating at $\omega = 5 \times 10^8$ rad/s. If the velocity on the line is 2.4×10^8m/s, find: (a) L; (b) C. (c) Let Z_L be represented by an inductance of $0.6\mu H$ in series with a 100Ω resistance. Find Γ and s.
4. Two characteristics of a certain lossless transmission line are $Z_0 = 50\Omega$ and $\gamma = 0 + j0.2\pi m^{-1}$ at $f = 60\ MHz$: (a)find L and C for the line. (b)A load $Z_L = 60 + j80\Omega$ is located at $z = 0$. What is the shortest distance from the load to a point at which $Z_{in} = R_{in} + j0$?
5. A transmitter and receiver are connected using a cascaded pair of transmission lines. At the operating frequency, line 1 has a measured loss of 0.1dB/m, and line 2 is rated at 0.2dB/m. The link is composed of 40m of line 1 joined to 25m of line 2. At the joint, a splice loss of 2dB is measured. If the transmitted power is 100mW, what is the received power?
6. A 100MHz voltage source drives the series combination of an impedance, $Z_g = 25 + j25\Omega$ and a lossless transmission line of length $\lambda/4$, terminated by a load impedance, Z_L. The line characteristic impedance is 50Ω. (a)Determine the load impedance value required to achieve a net impedance (seen by the voltage source) of 50Ω. (b) If the inductance of the line is $L = 1\mu H/m$, determine the line length in meters.
7. A 1000-m-long communication line has the following per-unit-length parameters: R_l = 22 mΩ/m, L_l = 0.63 μH/m, G_l = 0.1 μS/m, C_l =31 pF/m. The resistive load at the receiving end of this line absorbs 10 W at 50 V (rms). Determine the sending-end voltage, current, and power for an operating frequency of 10 kHz.
8. A 10-m-long lossless transmission line feeds a load having an impedance of 35 + j10 Ω. The load voltage is $\sqrt{2} \times 50\ cos 10^8 t\ V$. The voltage applied to the line is $\sqrt{2} \times 66\ cos(10^7 t + 31^0)V$. Calculate the distributed inductance and capacitance of the line.
9. The incident voltage wave on a certain lossless transmission line for which $Z_0 = 50\Omega$ and $v_p = 2 \times 10^8\ m/s$ is $V^+(z,t) = 200\cos(\omega t - \pi z)$ V. (a) Find ω. (b) Find $I^+(z,t)$. The section of the line for which $z > 0$ is replaced by a load $Z_L = 50 + j30\Omega$ at $z = 0$. Find (c) Γ_L ; (d)$V_s^-(z)$; (e) V_s at $z = -2.2$ m.
10. A 50Ω lossless line is terminated with 60 and 30Ω resistors in parallel. The voltage at the input to the line is $v(t) = 100\cos(5 \times 10^9 t)$ and the line is three-eighths of a wavelength long. What average power is delivered to each load resistor?
11. A lossless transmission line is 50 cm in length and operating at a frequency of 100 MHz. The line parameters are $L =$ 0.2 μH/m and $C = 80pF/m$.The line is terminated in a short circuit at $z = 0$, and there is a load $Z_L = 50 + j20\Omega$ across the line at location $z = -20cm$. What average power is delivered to Z_L if the input voltage is $100\angle 0^0$ V?